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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/982,003	10/19/2001	Miyoko Shimada	04329.2688	7125

7590 02/21/2003

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EXAMINER
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ART UNIT	PAPER NUMBER
2829	

DATE MAILED: 02/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/982,003	SHIMADA ET AL.	
	Examiner	Art Unit	
	Lisa A Kilday	2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *amendment on 12/12/02* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6-11 and 13-19* is/are rejected.

7)☒ Claim(s) *5 and 12* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1, 8 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "predetermined" in claims 1 & 8 is a relative term, which renders the claim indefinite. The term "predetermined" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The use of "predetermined" in claims 1 & 8 reads on a nebulous mental step conducted prior to the manipulative steps of the claimed process, hence rendering the present process claim unclear in meaning in scope. If applicant wishes to patent detail controls over the recited process, then the process steps must be positively recited. See Seagram & Sons Inc. vs. Marshall, 84 USPQ 180. Replacing the word "predetermined" with the actual temperature change, such as 400C to 200C, would over come this rejection.

Specification

Claims amended to overcome objections. Objections withdrawn.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-4, 7-11, 14-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Livesay et al. (WO 96/36070). In re claim 1, Livesay et al. discloses a method of manufacturing a semiconductor device in fig. 2 comprising: preparing a substrate (27) to be treated; and forming an insulation film (28) above the substrate, which includes applying an insulation film raw material above the substrate (pg. 9 line 10), the insulation film raw material including a substance or a precursor of the substance (pg. 2 lines 20-24), the insulation film comprising the substance (pg. 9 line 10), curing the insulation film raw material by irradiating an electron beam (45) on the substrate while heating the substrate in a reactor chamber (pg. 8 lines 19-25), changing at least one of parameter selected from the group consisting of pressure in the reactor chamber, temperature of the substrate (pg. 9 lines 15-23), type of gas having the substrate exposed thereto, flow rate of a gas introduced into the reactor chamber, position of the substrate, and quantity of electrons incident to the substrate per unit time when the electron beam is being irradiated on the substrate (pg. 9 lines 19-23, pg. 10 lines 21-24). Livesay-1 teaches heating gradually to a predetermined temperature. Livesay-1 teaches turning off the infrared quartz lamps off and on to varying duty cycle to control the wafer temperature (pg. 9, lines 20-23). Livesay-1 teaches using the lamps (23) to irradiate and heat the substrate thereby controlling its temperature (pg. 9, lines 13-14).

In re claim 2, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 1, wherein the pressure in the reactor

chamber is changed in a range from higher than 0 Torr to not more than 40 Torr (pg. 8 lines 20-21).

In re claim 3, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 1, wherein the temperature of the substrate is changed in a range from not less than 200 °C to not more than 500 °C (pg. 9 lines 19-20).

In re claim 4, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 1, wherein type of gas having the substrate exposed thereto is changed among a nitrogen gas, a rare gas, a reduced gas and a mixture of these gases, and whose oxygen concentration is not higher than 100 ppm (pg. 2 lines 6-7).

In re claim 7, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 1, wherein the quantity of electrons incident to the substrate per unit time is changed in a range from not less than 4 $\mu C/cm^2 \cdot$ sec to not more than 10 $\mu C/cm^2 \cdot$ sec (pg. 5 lines 22-23).

In re claim 8, A method of manufacturing a semiconductor device according to claim 1, further comprising:

at least one of pre-heat treatment which carried out before curing the insulation film raw material (pg. 10 lines 28-29, pg. 11 lines 18-26) and post-heat treatment which carried out after curing the insulation film raw material in the reactor chamber (pg. 14, claim 6 lines 1-15), changing at least one of parameter selected from the group consisting of pressure in the reactor chamber, temperature of the substrate (pg. 9 lines 15-23), type

of gas having the substrate exposed thereto, flow rate of gas introduced into the reactor chamber, and position of the substrate when the at least one of the pre-heat treatment and the post-heat treatment is being carried out.

In re claim 9, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 8, wherein the pressure in the reactor chamber is changed in a range from higher than 0 Torr to not more than 40 Torr (pg. 8 line 21, pg. 13 claim 2) when the at least one of the pre-heat treatment and the post-heat treatment is being carried out.

In re claim 10, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 8, wherein the temperature of the substrate is changed in a range from not less than 200C to not more than 500C when the at least one of the pre-heat treatment and the post-heat treatment is being carried out (pg. 9 lines 19-20).

In re claim 11, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 8, wherein type of gas having the substrate exposed is changed among a nitrogen gas, a rare gas, and a mixture these gases whose oxygen concentration is not higher than 100 ppm when the at least one of the pre-heat treatment and the post-heat treatment is being carried out (pg. 2 lines 6-7).

In re claim 14, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 1, wherein the insulation film is an organic silicon oxide film (pg. 1 lines 28-30 – pg. 2 lines 1-2, lines 20-26).

In re claim 15, Livesay et al. discloses a method of manufacturing a semiconductor device according to claim 8, wherein the insulation film is an organic silicon oxide film (pg. 10 lines 21-23).

Claim Rejections - 35 USC § 103

Claims 6 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Livesay et al. (WO 96/36070) in view of Livesay (5,003,178). Livesay et al. (WO) teaches a method of manufacturing a semiconductor device in figure 2 by applying insulation film raw material, and curing the insulation film raw material by irradiating an electron beam on the substrate while heating the substrate in a reactor chamber. However, Livesay et al. (WO) does not teach that the position of the substrate is changed in a range from not less than 50 mm to not more than 120 mm in distance from an electron beam generating section that generates the electron beam. However, Livesay (US) teaches in figure 3 adjusting the position of the substrate (30) in a range from not less than 50 mm to not more than 120 mm in distance from an electron beam generating section that generates the electron beam (col. 6 lines 15-26). Therefore it would be obvious to one skilled in the art at the time of the invention to modify the process of Livesay et al. (WO) by adjusting the position of the substrate with respect to the electron beam generating section in order to diffuse the electron beam in a fairly uniform current density across the whole emitting area.

Claims 16-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Livesay et al. (WO 96/36070) in view of Goo et al. (5,989,983). In re claims 16 & 17, Livesay et al. (WO) teaches a method of manufacturing a semiconductor device in

figure 2 by applying insulation film raw material, and curing the insulation film raw material by irradiating an electron beam on the substrate while heating the substrate in a reactor chamber. However, Livesay et al. (WO) does not teach that the insulation film is a polymethylsiloxane film. However, Goo et al. teaches in figures 1A and 1B applying Spin-On-Glass (SOG) (ref. 13) and curing this layer with e-beam (18) (col. 4 lines 56-60, col. Goo et al. teaches that the SOG is polymethylsiloxane (col. 1 lines 43-52). Therefore it would be obvious to one skilled in the art at the time of the invention to modify the process of Livesay et al. (WO) by substituting Cu for Aluminum as the wire's main material in order to deposit a SOG at low temperature for better planarization and excellent crack resistance.

In re claims 18 and 19, Livesay et al. (WO) teaches a method of manufacturing a semiconductor device in figure 2 by applying insulation film raw material, and curing the insulation film raw material by irradiating an electron beam on the substrate while heating the substrate in a reactor chamber and embedding a wire on a surface of the insulation film. However, Livesay et al. (WO) does not teach that the wire's main material is Cu on a surface of an insulation film. However, Goo et al. teaches in figure 3A embedding a wire whose main material is Cu (21), (col. 7 lines 43-51). Therefore, it would be obvious to one skilled in the art at the time of the invention to modify the process of Livesay et al. because it is well known in the art that Copper is a common substitute for Aluminum wiring.

Allowable Subject Matter

Claims 5,12 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: prior art does not teach or suggest a method of manufacturing a semiconductor device according, wherein the flow rate of gas having the substrate exposed thereto, the gas being introduced into the reactor chamber, is changed in a range of from higher than 0 slim to not more than 25 slim during either the pre-heat or post-heat treatment.

Response to Arguments

Applicant's arguments filed 12/12/02 have been fully considered but they are not persuasive. Livesay-1 rejects claims 1-4, 7-11, 14, and 15 under U.S.C. § 102 (b). Applicant's representative argues that claim 1 is distinguished over Liversay-1 because Livesay does not teach "wherein the substrate temperature is changed by a predetermined amount during the electron beam irradiating process." This is incorrect for four reasons. First, the "predetermined" amount is indefinite. See 112, ¶2 rejection above. Second, all temperature changes are gradual and inherent in an electron beam irradiating process. Note that all temperature profiles must be somewhat gradual because according to heat transfer laws the temperature of the insulation layer would not instantaneously reach the desired temperature. Third, Livesay-1 does not teach keeping the substrate temperature at a constant temperature. Livesay-1 teaches turning off the infrared quartz lamps off and on to varying duty cycle to control the wafer temperature (pg. 9, lines 20-23). Livesay-1 teaches using the lamps (23) to irradiate and heat the substrate thereby controlling its temperature (pg. 9, lines 13-14). Livesay-1 teaches heating gradually to a predetermined temperature. Finally, Livesay-1 does

teach that the substrate temperature is changed by a predetermined amount during the electron beam irradiating process (pg. 11, lines 18-26) because the wafer temperature at the beginning of the irradiation is at room temperature and is gradually heated by electron beam by a predetermined amount.

On pg. 9 of the applicant's response, applicant's representative argues that Livesay-2, taken alone or in combination with Livesay-1, does not teach or suggest claim 1. In re claim 1, Livesay et al. discloses a method of manufacturing a semiconductor device in fig. 2 comprising: preparing a substrate (27) to be treated; and forming an insulation film (28) above the substrate, which includes applying an insulation film raw material above the substrate (pg. 9 line 10), the insulation film raw material including a substance or a precursor of the substance (pg. 2 lines 20-24), the insulation film comprising the substance (pg. 9 line 10), curing the insulation film raw material by irradiating an electron beam (45) on the substrate while heating the substrate in a reactor chamber (pg. 8 lines 19-25), changing at least one of parameter selected from the group consisting of pressure in the reactor chamber, temperature of the substrate (pg. 9 lines 15-23), type of gas having the substrate exposed thereto, flow rate of a gas introduced into the reactor chamber, position of the substrate, and quantity of electrons incident to the substrate per unit time when the electron beam is being irradiated on the substrate (pg. 9 lines 19-23, pg. 10 lines 21-24). However, Livesay (1) does not teach that the position of the substrate is changed in a range from not less than 50 mm to not more than 120 mm in distance from an electron beam generating section that generates the electron beam. However, Livesay (2) teaches in figure 3

adjusting the position of the substrate (30) in a range from not less than 50 mm to not more than 120 mm in distance from an electron beam generating section that generates the electron beam (col. 6 lines 15-26). Therefore it would be obvious to one skilled in the art at the time of the invention to modify the process of Livesay (1) by adjusting the position of the substrate with respect to the electron beam generating section in order to diffuse the electron beam in a fairly uniform current density across the whole emitting area.

On pg. 9, ¶3, applicant's representative asserts that Livesay-1 does not teach or suggest claim 1, and therefore, claims 6 and 13 are not obvious. This argument is moot because the applicant does not provide any specific reasoning why claims 6 and 13 are not obvious.

Applicant's representative argues that Livesay-2 does not cure the deficiencies of Livesay-1 with the newly added limitation in claim 1. This reasoning is wrong because Livesay-1 does teach the limitation of "wherein the substrate temperature is changed by a predetermined amount during the electron beam irradiating process." Please refer to the arguments above. Furthermore, Livesay-2 is applied to teach the limitations of the substrate distance from the electron beam, not the newly added limitation in claim 1.

On pg. 10, ¶1, applicant's representative argues that Livesay-2 is different from the instant invention because "the substrate stays at room temperature". This argument is not persuasive because "the substrate stays at room temperature" is not found in the claims. Applicant's point is moot because this limitation is not in claim 1, 6, or 13.

On pg. 10, ¶3 – pg. 11, applicant argues that it would not be obvious to combine Livesay-1 and Livesay-2 because in Livesay-2 "the substrate stays at room temperature." Again, applicant's point is moot because this limitation is not found in the claims.

On pg. 12, applicant argues that Livesay-1 does not teach or suggest claim 1 and therefore claims 16-19 are non-obvious. This argument is moot because the applicant does not provide any specific reasoning why claims 16-19 are not obvious.

On pg. 12 ¶4, applicant argues that Goo does not teach the newly added limitation of: "wherein the substrate temperature is changed by a predetermined amount during the electron beam irradiating process." This reasoning is wrong because Livesay-1 does teach the limitation of "wherein the substrate temperature is changed by a predetermined amount during the electron beam irradiating process." Please refer to the arguments above. Furthermore, Goo teaches that the electron beam when the curing temperatures between room temperature and 500C (col. 5 lines 62-63). Since heating is gradual not instantaneous, the substrate temperature is changed by a predetermined amount during the electron beam irradiating process.

Applicant argues that Livesay-1 cannot apply Goo to teach polymethylsiloxane film and that the wire's main material is Cu because Goo does not teach or suggest **all** of the limitations of claim 1. Examiner finds the applicant's representative argument confusing. First, Goo is relied upon for the limitations of polymethylsiloxane film in claims 16 & 17, and that the wire's main material is Cu in claims 18-19. Second, these limitations are not found in claim 1. Livesay-1 teachings are relied upon for claim 1.

Third, Goo and Livesay-1 are combinable references. Finally, it is well known in the art and taught in Goo that polymethylsiloxane is a type of SOG. It is also well known in the art that Cu is a material used for wiring.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is (703) 308-0957. See MPEP 203.08.

Any inquiry concerning this communication from the examiner should be directed to Lisa Kilday whose telephone number is (703) 306-5728. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamand Cuneo, can be reached on (703) 308-1233. The fax number for the group is (703) 305-3432. MPEP 502.01 contains instructions regarding procedures used in submitting responses by facsimile transmission.

Lisa Kilday

LAK

2/11/03

ERNEST KARLSEN
PRIMARY EXAMINER